DOCUMENT RESUME

ED 256 508 PS 015 123

AUTHOR Nelson, Charles A.
TITLE Electrophysiological Correlates of Infant Recognition Memory: The Late Positive Component (LPC).
PUB DATE Apr 85
NOTE 31p.; Paper presented at the Biennial Meeting of the Society for Research in Child Development (Toronto, Ontario, Canada, April 25-28, 1985).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Cognitive Ability; *Electroencephalography; Habituation; *Infants; Novelty (Stimulus Dimension); *Recognition (Psychology); *Short Term Memory; Visual Stimuli
IDENTIFIERS Brain Activity; Brain Research; *Brain Waves; *Late Positive Component (EEG)

ABSTRACT

A series of studies has investigated the possibility that human infants performing tasks exhibit something like the P300, a positive-going brain wave associated with task performance and the updating of working memory among adults. Findings indicate that, when infants have the opportunity to form a template against which to compare a previously unseen or novel stimulus, they are able to manifest their updating of this template regardless of how frequently the previously unseen or novel stimulus is presented. More importantly, infants at 4 months are capable of forming a template to a class of stimuli and then periodically updating that template when stimuli of a second class are presented. Collectively, both lines of evidence lend strong support to the notion that the observed responses are endogenous in nature. While such findings have been obtained using paradigms and procedures quite different from those used in behavioral studies, they by and large support what has been reported in the behavioral literature. Whether in fact the observed components can be considered an electrophysiological analogue of dishabituation or response to novelty remains to be seen. Nonetheless, findings overall do extend the view of infants' perceptual and cognitive abilities beyond the picture presented by behavioral evidence. Reproductions of study slides used during the presentation are appended. (RH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)
X This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED256508

Electrophysiological Correlates of Infant Recognition Memory: The Late Positive Component (LPC).

Charles A. Nelson

Department of Psychological Sciences

Purdue University

West Lafayette, IN 47907

Based on a paper presented as part of a symposium entitled "Event-Related Potentials of the Brain and Perceptual/Cognitive Processing of Infants," Society for Research in Child Development, Toronto, Canada, April, 1985

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Charles A. Nelson
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

PS 015123

As this audience is well aware, in the past 20 years we have witnessed a tremendous increase in our knowledge of the young infant's perceptual and cognitive abilities. With few exceptions, much of this research has utilized as the dependent measure some behavioral index, such as visual fixation, sucking, reaching, or head turning (for reviews, see Banks & Salapatek, 1983; Olson & Sherman, 1983). Thus, while these measures have provided a window through which to observe the behavioral manifestation of these abilities, little progress has been made in studying the brain's relation to these abilities. Since most would agree that the brain is the substrate for perception and thought, it would seem critical to study directly the role this particular organ plays in mediating such processes as discrimination, memory, and categorization, to name just a few. In the work I'll be discussing today, it is through the use of recording event-related potentials that this goal was attempted.

There are many procedures that allow one to image the workings of the brain. For one reason or another, however, most of these - for example, CAT, PET, NMR, SQUID, to name just a few - are unsuitable for use with human infants (e.g., invasive, etc.). One that is suitable, however, is the electrophysiological procedure called the Event-Related Potential or ERP. The ERP is an electrophysiological response that is generally recorded at the surface of the scalp, and is in fact a component of the EEG. It is most often detected by recording a subject's EEG while he/she is engaged in some task. The subject's brain response is then time-locked to the repeated presentation of some stimulus or class of stimuli, and these responses are then filtered, amplified, and, to improve the signal-to-noise ratio, averaged. The resulting brain potentials can then serve as an index of a variety of sensory, perceptual, and cognitive phenomena.

While the general rationale for studying late components in infants has already been spelled out for you, my interest is in one particular late

component - the P300 or LPC. In adults the P300 is a positive-going wave with a latency of at least 300 to 500 msec that occurs to, among others, task-relevant events, and that has a parietal-central scalp distribution (e.g., Donchin, Ritter, & McCallum, 1978). Because the LPC has proven useful in adult studies of, for example, match/mismatch operations, responses to stimulus novelty or uncertainty, and memory and categorization, it would seem that the LPC might also prove useful in studying similar processes in infants. One question that must be raised, however, is whether one could predict apriori there to exist in infants anything like a P300. A related question is whether there is any evidence for or against this prediction.

There are two reasons for answering the first question in the "qualified" affirmative. First, there have been reported in cats (Wilder, Farley, & Starr, 1981), rats (O'Brien, 1981), rabbits (Donchin, personal communication), and monkeys (e.g., Arthur & Starr, 1984) something that looks very much like a P300. Thus (if I can stick my neck out), if one can obtain the response in these organisms under conditions similar to those of the adult human, one would think that a <u>similar</u> (and I emphasize the term "similar," for reasons to be described below), response should be manifested in the human infant. Second, while models of the P300 abound, I think most would agree that the response reflects some aspect of Short-Term Memory (STM). For example, I am by and large in agreement with Donchin and his colleagues in thinking that the response reflects the updating of working memory (e.g., Donchin, 1981; Karis, Fabiani, & Donchin, 1984; Klein, Coles, & Donchin, 1984). Thus, if an infant is presented with a train of two stimuli, one of which is presented more frequently than the other, and we assume that a template has been formed for the more frequently presented stimulus, a P300 should be invoked only to the stimulus that departs from the template (i.e., the rare stimulus). The fact that infants in a behavioral

paradigm show evidence of dishabituation or response to novelty suggests that such "updating" is possible early in life.

Based on the above logic, one is tempted to speculate that there should be something like a P300 in infants. However, it is unlikely that such a response would look exactly like an adult's. For example, undermylinezation of infant cortex should result in slower conduction velocities, which might in turn result in longer latencies. Similarly, volume conduction differences coupled with the thinner nature of the infant's skull should result in responses that are larger in infants than in adults. Finally, we know that stimulus evaluation time critically influences the latency of P300 in the adult (e.g., Magilero, Bashore, Coles, & Donchin, 1984). Thus, one should therefore expect a corresponding increase in latency in the infant, whose information processing skills are generally thought to be inferior to those of the adult. Despite these differences in latency and form, however, the critical point is that the response is a manifestation of the same process (or processes). Thus, it is here where the title of my talk is misleading; while it will be clear that my data do not necessarily resemble an adult P300, I will claim that the responses I'm recording are nevertheless invoked under similar conditions as those of the adult, and thus manifest a similar process.

Now, what is the direct evidence for such a proposition? Very simply, the evidence is mixed. Some - Eric for example - have reported pre-frontal and frontal long-latency negative (circa 700 msec) and positive (circa 1350) waves in response to a "rare" event (Courchesne, Ganz, & Norcia, 1981). In contrast, Hofmann and Salapatek have reported posterior and posterior-central positive waves with a latency of approximately 300 to 500 msec in response to a rare event (Hofmann & Salapatek, 1981; Hofmann, Salapatek, & Kuskowski, 1981). Unfortunately, as I think Eric will be discussing, these particular studies are so methodologically dissimilar that it may be impossible to reconcile the

differences. However, what both studies do suggest is that one can at least record late potentials that discriminate between stimuli presented with low vs. high probability. This in itself is encouraging, but is not evidence that the reported components were endogenous. Indeed, given the nature of the tasks used by both sets of investigators (infants were presented with an interlace of high and low probability stimuli), it is possible that infants were responding to a physically rare event, and not necessarily to a "task-relevant" event.

How might one circumvent the above problem of demonstrating that a particular component is or is not endogenous? We saw three possibilities, although only two of these approaches will be discussed today. First, one might present infants with a train of stimuli, of which a small number are omitted, and make such omissions "task-relevant." If a response occurs to the omitted stimulus, one can at least rule out some physical aspect of the stimulus as mediating the response. Second, one might present infants with an interlace of stimuli presented with equal probability, some of which are relevant to attend to and others of which are not. If a response occurs that discriminates between the two events, one could rule out physical rarity as contributing to the response. Third, one could attempt to invoke the response to a category of events. Thus, for this to occur would require that infants categorize the stimuli, and not attend solely to some physical dimension of the task or event. As I indicated a second ago, in our work all three of these questions were addressed, although today I will be restricting my discussion to the latter two.

BACKGROUND INFORMATION: In the first three studies, we used as stimuli a male and a female Caucasian face that had been shown in an earlier behavioral study to be discriminable. These stimuli were matched for luminance and visual angle, and were rear projected for 100 msec. We presented these stimuli every 1000 msec, and recorded during this entire epoch. The EEG was recorded every 10

msec from Oz, Pz, Cz, and Fz (the Pz data won't be reported, as there were very few). The subjects were all 6 months old, and were tested on their parent's lap facing a translucent stimulus screen.

The basic procedure involved rubbing the infant's head lightly with alcohol to remove scalp oils, placing Grass AgCl electrodes (according to the International 10/20 system) on the scalp with adhesive foam padding and headbands, and placing two miniature Beckman eye electrodes above and below one eye in a transverse configuration (thus maximizing the likelihood of detecting both vertical and horizontal eye movements). All electrodes were referenced to the right mastoid and grounded to the forehead. Following electrode placement the infant and parent were brought into the testing room, whereupon the infant was seated on the parent's lap facing a translucent screen on which the stimuli were rear projected.

The design of the first study can be seen in the next slide, along with a summary of the relevant technical information.

INSERT DESIGN SLIDE OF STUDY 1

Basically, infants were presented with 40 familiarization trials (100% condition) of one face, followed by a test period of 120 test trials, of which 80% were of the previously seen face and a random 20% were of a previously unseen face. After a short break a second familiarization and test period followed, in which the probability of the two faces occurring was reversed (i.e., the face that had previously served as the 100% and 80% stimuli now became the 20% stimulus and vice versa). The rationale for the familiarization period was basically to provide infants with exposure to one stimulus, thereby making the to-be-seen "rare" stimulus more novel. This is an important point, as in the adult version of the oddball paradigm, subjects are verbally

instructed to attend to one stimulus or another, and it is this "task-relevant" stimulus that invokes the P300. One cannot issue such instructions to infants, of course, and thus the need for something like a familiarization period.

The order of stimulus presentation was counterbalanced across infants. Trials during which the infant failed to pay attention were edited on-line (vis a vis an observer), while eye and other artifacts were edited off-line.

After all the data were edited, the 20% trials were averaged. (Through pilot work we decided to keep an infant's data only if there were 10 or more such trials.) An equal number of 80% and 100% trials were then selected and averaged, and the three curves were superimposed relative to the mean of the N1,P2 complex. (We also used the first 30 msec as baseline and this didn't change the results.) The interval between 250 and 1000 msec was parsed into 150 msec intervals, and the area underneath the curve in each interval was then calculated for each of the three conditions (20%, 80%, and 100%) relative to baseline. The different conditions were then compared to one another using a Wilcoxon Matched Pairs Signed Ranks test. This was done for all three scalp leads.

The major findings to emerge from the analyses were as follows. First, in all three conditions (i.e., 20%, 80%, 100%) there was a prominent positive peak at Oz beginning at approximately 400 msec. There were, however, no differences between the 20%, 80%, and 100% conditions, and thus one could draw few conclusions regarding the subjects' response to the rare event. The grandmean for the Oz data can be seen in the next slide.

INSERT SLIDE OF Oz DATA, STUDY 1

The picture was entirely different at Cz and Fz. At both these locations we

saw a general (i.e., over all conditions) positive-negative-positive waveform that was distributed between 250 and 1000 msec. At both scalp sites the 20% condition was significantly more positive than the 100% condition in the 551 to 700 msec interval, although of course one can see that the entire complex is negative in this interval. Shortly thereafter (851-1000 msec) the 20% condition departed (i.e., was more positive) from the 80% condition. Here the entire waveform was positive.

INSERT SLIDES OF Cz, Fz DATA, STUDY 1

The fact that the 20% condition was significantly different from the 100% condition allowed us to conclude that infants had discriminated the rare from the frequent faces. Moreover, such evidence was only forthcoming at central and frontal sites. It is intriguing to note that the positive wave found at Oz resembled in form and latency the P300 reported in adults, although it did not discriminate between conditions. Moreover, the differences at Cz and Fz may actually have represented two separate processes (components); that is, between roughly 551 and 700 msec infants realize that, unlike the 100% condition, two events are now being presented (this is reflected by the 20% vs. 100% difference, and the lack of a difference between 20% and 80%). Shortly thereafter (851 to 1000 msec), they identify what this difference is; that is, that the 20% (novel) and 80% (familiar) stimuli are different. Whether these are indeed two separate components that index two separate processes (e.g., an LPC or LNC and a SW), or one component that is distributed in time, we cannot at the present time say. It would also be premature to give these components labels.

The above findings suggest that infants discriminated the rare from the frequent stimuli. What is still not known, however, is whether this was a

response to the relevant aspects of the task, or simply a response to a low probability event (explain). To tease apart these explanations, two additional studies were conducted. Specifically, if the effect observed in the 20% condition was invoked because it was task relevant, then the effect should still obtain, albeit in diminished form, when the novel and familiar stimuli are presented with equal probability. Similarly, if the 100% condition serves as a period of instruction, thereby defining for the infant what is or is not task relevant, then no LPC should be present when this period of instruction is deleted. These were the goals of Studies 2 and 3.

To test these claims, infants in Study 2 received a familiarization period (100% condition), followed by a test period containing an equal (but random) mix of novel and familiar stimuli.

INSERT DESIGN SLIDE OF STUDY 2

Infants in Study 3 received only the 50%/50% mix of test stimuli.

INSERT DESIGN SLIDE OF STUDY 3

Based on adult findings (e.g., Duncan-Johnson & Donchin, 1977) and the findings of Study 1, it was predicted that the earlier findings should obtain again, albeit in diminished form, in Study 2 but <u>not</u> in Study 3.

The data were reduced and analyzed as before, and the results in part confirmed the above prediction. The only significant difference to emerge was in Study 2, in which the "relevant" stimulus (i.e., labeled "20%" in the figure) was more positive than the familiar stimulus (labeled 100% in the figure) for the interval between 551 and 700 msec at the Cz lead. The grandmeans for this

lead in both studies can be seen in the next two slides.

INSERT SLIDES OF Cz DATA, STUDIES 2 AND 3

Several conclusions can be drawn from the above findings. First, while the form and latency of the observed response departs from that which is recorded in adults (except at Oz), the events that underlie the response appear quite similar. Specifically, when an infant's attention was drawn to the "relevant" aspects of the task by pre-exposing one stimulus, an electrophysiological difference manifested itself even when the novel and familiar stimuli occurred with equal probability. Second, this difference expressed itself only over central-frontal scalp regions. Thus, like the adult LPC, the infant "LPNPC" seems to be invoked under similar conditions, and to have a similar scalp distribution. Third, when the results of the studies that employed a 100% condition are compared to the one that did not, it is tempting to conclude that the brief familiarzation period did indeed direct the subject's attention to the relevant aspects of the task, as without this condition no response was present. It is also interesting to note that in Study 1, infants seemed to go through a two step selection process in evaluating the stimuli during the test trials. The first step seemed to involve registering the difference between the 100% familiarization condition and the 20%/80% test condition (explain), while the second step involved indentifying what this difference was. However, <u>both</u> these steps appeared to be lacking at Fz when the novel and familiar stimuli were presented with equal probability (Study 2), while only the <u>second</u> step appeared to be lacking at Cz. While recognizing that the events presented during the test trials are different from those presented during the familiarzation trials (step 1) is still indicative of memory and discrimination, it is not indicative

of identification. Thus, it may be necessary to present the rare stimulus less frequently than the familiar stimulus (as was done in Study 1) in order to highlight the difference between stimuli (vis a vis decreasing the difficulty of the task), and to involve more frontal brain sites.

The findings from Study 2 are encouraging, as they suggest that the differential responding observed at Cz between 551 and 700 msec was not a response to a physically rare event. This lends support to the endogenous nature of the component. However, it is possible that the response was due to some physical difference between the stimuli. To address this issue, we conducted a fourth and final study. Here the goal was not to ask infants to respond to a rare stimulus per se, but rather, to a rare category of stimuli. The categories we chose were male and female faces.

The design of the categorization study can be seen in the next slide, which I hasten to add is not yet complete. Both 4- and 6-month-old infants served as

---

INSERT DESIGN SLIDE OF CATEGORIZATION STUDY

---

subjects, although the 6 month data are not yet complete and I will therefore refrain from discussing them. The testing conditions were the same as before, as was the general procedure. There were three exceptions to this, however. First, data were also collected at Pz. Second, the recording epoch was 1200 msec instead of 1000 msec. Third, we altered the familiarzation period from that used in the first set of studies. That is, while the previous studies indicated that a 100% condition was necessary to invoke the response, this condition unfortunately contributed to our attrition rate, as it necessitated that the subject stay in the study longer. Thus, we modified the procedure here, such that infants were presented with a continuous exposure of a single exemplar from one category (e.g., "Tom") until they had accumulated 30 sec of

viewing time. No EEG was recorded during this phase. The stimuli were 6 male and 6 female faces, matched for luminance and visual angle. Two hundred test trials immediately followed this familiarization phase, of which 80% contained 6 exemplars of the same category (e.g., males), and a random 20% contained 6 exemplars of a different category (e.g.,females). The order of stimulus presentation was counterbalanced across infants.

The data were reduced and analyzed as before. The findings from the 4-month olds can be seen in the next slide. At Oz the only difference to emerg between the 20% and 80% conditions occurred between 551 and 700 msec. This same interval, plus the 701 to 850 msec interval, was also significant at Pz and Cz. There were no significant differences to emerge at Fz.

INSERT SLIDE OF 4 MONTH DATA, CATEGORIZATION STUDY

What can we conclude of the 4 month data? First, it is interesting to note that the general shape of the waveforms at Oz, Cz, and Fz is similar to those reported earlier. Thus, the data appear internally consistent in that they replicate from study to study. Second, the 20% vs. 80% conditions differed maximally at the parietal and vertex scalp sites, which is consistent with the adult data. Third, the first component, or interval, that I discussed in Studies 1 and 2 - that is, the 551 to 700 msec interval - again discriminated between the rare and frequent conditions. However, unlike the first set of studies with 6 month olds, this finding obtained in part at Oz and did <u>not</u> obtain at Fz. Thus, the response seems to have moved in a more posterior direction. Whether this can be attributed to the task or to the age group we do not know. Fourth, while the late interval I talked about in the first three studies - that between 851 and 1000 - itself did not reach significance, the interval right before this did - that between 701 and 850 msec. Piecing things

together, the fact that only the earlier interval was significant at Oz, but that both intervals were significant at Pz and Cz, suggests that these are, in fact, two separate components and/or two separate processes. This is reflected by the fact that there was independence between brain sites.

To summarize: When infants have the opportunity to form a template against which to compare a previously unseen or novel stimulus, they are able to manifest their updating of this template regardless of how frequently (or infrequently) the previously unseen or novel stimulus is presented. More importantly, infants at 4 months are capable of forming a template to a class of stimuli, and then periodically updating this template when stimuli of a second class are presented. Collectively, both lines of evidence lend strong support to the notion that the observed responses are endogenous in nature. While such findings were obtained using paradigms and procedures quite different from those used in behavioral studies, they by and large support what has been reported in the behavioral literature. Whether, in fact, the observed components can be considered an electrophysiological analogue of dishabituation or response to novelty remains to be seen. Nonetheless, the findings overall do clearly extend our view of infants' perceptual and cognitive abilities beyond what the behavioral evidence has told us.

References

Arthur, D.L., & Starr, A. (1984). Task-relevant late positive component of the auditory event-related potential in monkeys resembles P300 in humans. Science, 223, 186-188.

Banks, M.S., & Salapatek, P. (1983). Infant visual perception. In P. Mussen (General Editor), Handbook of child psychology, Vol. 2, Infancy and developemntal psychobiology. (435-571). (M.M. Haith & J.J. Campos, volume editor). New York: Wiley.

Courchesne, E., Ganz, L., & Norcia, A.M. (1981). Event-related brain potentials to human faces in infants. Child Development, 52, 804-811.

Donchin, E. (1981). Surprise!...Surprise? Psychophysiology, 18, 493-513.

Donchin, E., Ritter, W., & McCallum, W.C. (1978). Cognitive psychophysiology: The endogenous components of the ERP. In E. Callaway, P. Tueting, & S.H. Koslow (Eds.), Event-related brain potentials in man. New York: Academic Press.

Duncan-Johnson, C.C., & Donchin, E. (1977). On quantifying surprise: The variations of event-related potentials with subjective probability. Psychophysiology, 14, 456-467.

Hofmann, M.J., & Salapatek, P. (1981). Young infants' event-related potentials (ERPs) to familiar and unfamiliar visual and auditory events in a recognition memory task. Electroencephalography and Clinical Neurophysiology, 52, 405-417.

Hofmann, M.J., Salapatek, P., & Kuskowski, M. (1981). Evidence for visual memory in the averaged and single trial evoked potentials in human infants. Infant Behavior and Development, 4, 401-421.

Karis, D. Fabiani, M., & Donchin, E. (1984). "P300" and memory: Individual differences in the Von Restorff effect. Cognitive Psychology, 16, 177-216.

Klein, M., Coles, M.G.H., & Donchin, E. (1984). People with absolute pitch

process tones without producing a P300. Science, 223, 1306-1309.

Magliero, A., Bashore, T.R., Coles, M.G.H., & Donchin, E. (1984). On the dependence of P300 latency on stimulus evaluation processes. Psychophysiology, 21, 171-186.

Olson, G.M., & Sherman, T. (1983). Attention, learning, and memory in infants. In P. Mussen (General Editor), Handbook of child psychology, Vol. 2, Infancy and developmental psychobiology (1001-1080). (M.M. Haith & J.J. Campos volume editor). New York: Wiley.

STUDY 1

EXPERMENTAL DESIGN

100% CONDITION: 40 TRIALS OF SAME STIMULUS (E.G., MALE FACE)

80%/20% TEST CONDITION: 120 TRAILS OF INTERLACE OF HIGH (80%) AND LOW (20%) PROBABILITY TRIALS. THE 80% TRIALS IDENTICAL TO PREVIOUSLY SEEN 100% TRIALS (E.G., MALE FACE), WHILE 20% TRIALS WERE OF PREVIOUSLY UNSEEN FACE (E.G., FEMALE).

BACKGROUND/TECHNICAL INFORMATION

SUBJECTS: 6 MONTHS, FULL TERM, NO BIRTH COMPLICATIONS.

STIMULI: ALL STIMULI REAR PROJECTED AND MATCHED FOR LUMINANCE (1.2 LOG FOOT LAMBERTS) AND SIZE (20 DEG). STIMULUS DURATION=100 MSEC, ISI=1000 MSEC.

SCALP LEADS: OZ, PZ, CZ, FZ (PZ AMPLIFIER PROBLEMATIC; FEW PZ DATA COLLECTED AND THUS NOT REPORTED); REFERENCED TO MASTOID; GROUND TO FOREHEAD; IMPEDANCES <5 KOHMS.

EYE LEADS: ABOVE AND BELOW ONE EYE; BIPOLAR RECORDING; IMPEDANCES <20 KOHMS.

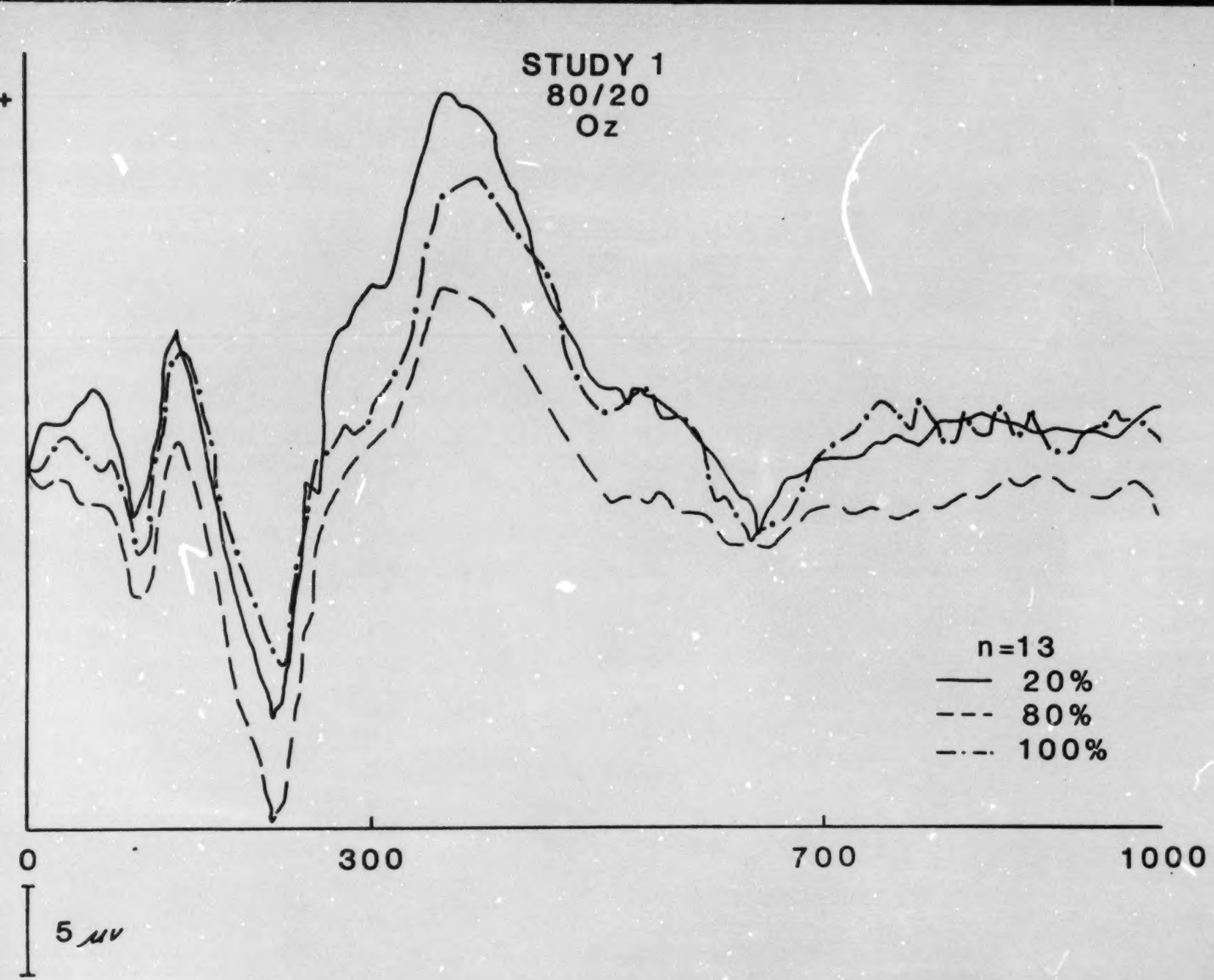
EEG: BECKMAN TYPE R DYNOGRAPH, MODEL 482 AMP, 9806 PREAMP.

TIME CONSTANT: .3 SEC

RECORDING EPOCH: 1000 MSEC (1 SAMPLE PER 10 MSEC)

EDITING: ON LINE: OBSERVER REJECTS TRIALS DURING WHICH INFANT FAILS TO PAY ATTENTION. OFF LINE: EYE MOVEMENTS ~>40-50 MICROVOLTS CAUSE REJECTION OF ALL SCALP LEADS; IF NO EYE MOVEMENTS, SCALP LEAD REJECTED IF OFF SCALE.

AVERAGING: REQUIRE MINIMUM OF 10 RARE-TRAILS FROM CZ LEAD TO USE DATA; INDIVIDUAL SUBJECT AVERAGE COMPUTED USING COMPARABLE NUMBER OF RARE AND FAMILIAR TRIALS


STUDY 1
80/20
Oz
+
n=13
20%
80%
100%
0
300
700
1000
5 μv

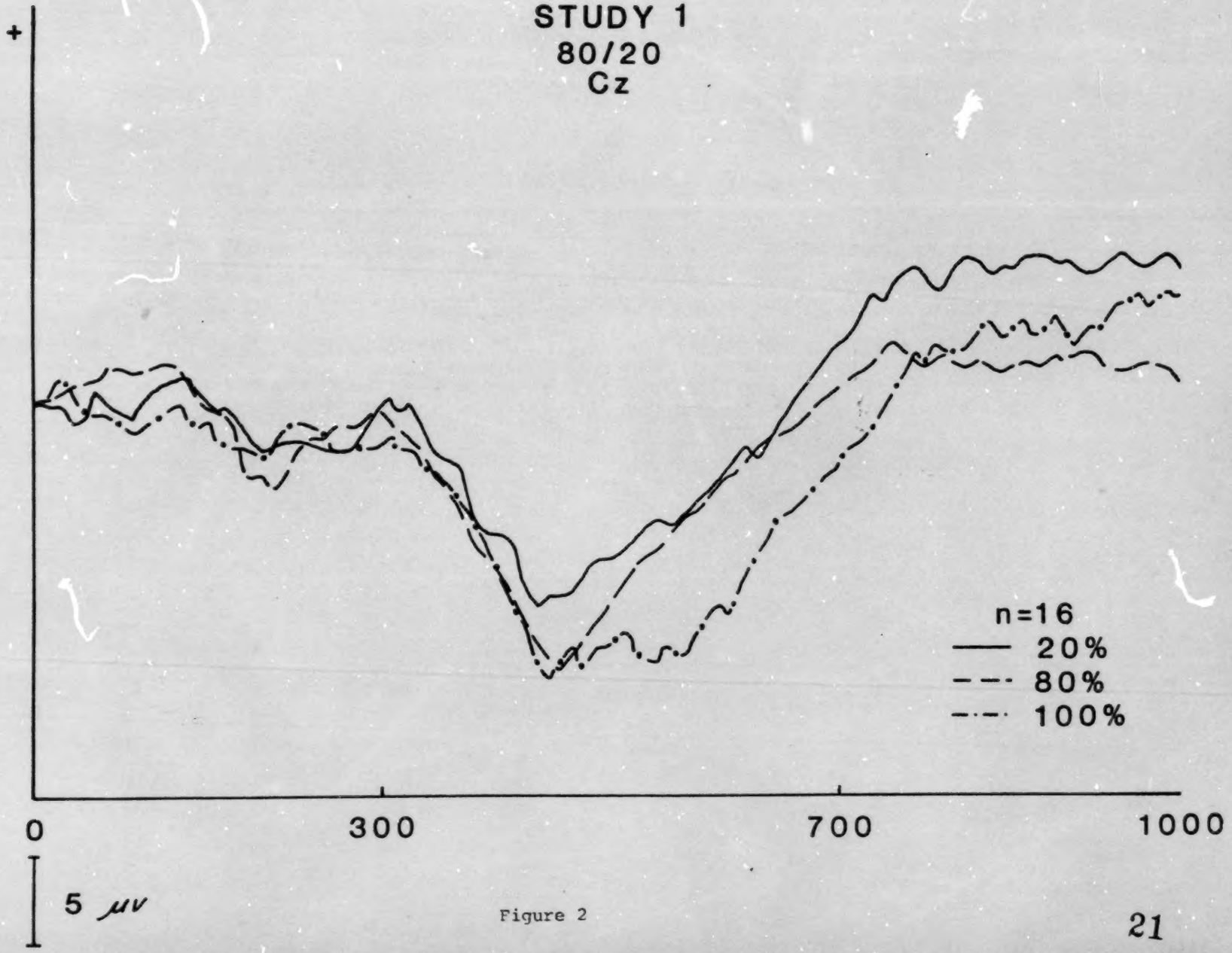


Figure 2

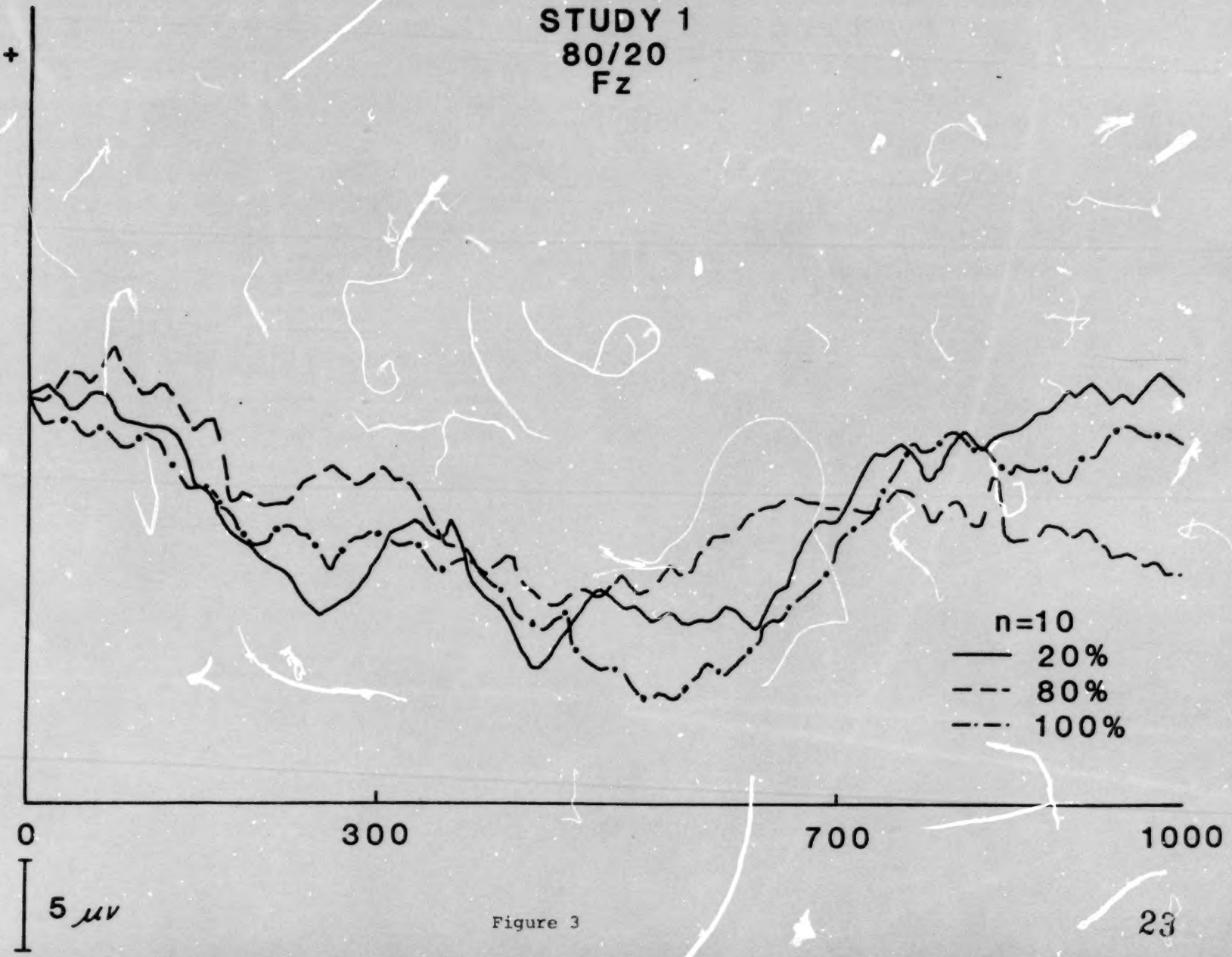


Figure 3

STUDY 2

EXPERIMENTAL DESIGN

100% CONDITION: 40 TRIALS OF SAME STIMULUS (E.G., MALE FACE)

50%/50% TEST CONDITION: 120 TRIALS OF INTERLACE OF PREVIOUSLY SEEN STIMULUS (E.G., MALE FACE) AND PREVIOUSLY UNSEEN STIMULUS (E.G., FEMALE FACE) PRESENTED RANDOMLY BUT WITH EQUAL PROBABILITY AS FAMILIAR STIMULUS.

BACKGROUND/TECHNICAL INFORMATION:

SAME AS STUDY 1

STUDY 3

EXPERIMENTAL DESIGN

50%/50% TEST CONDITION: 120 TRIALS OF INTERLACE OF TWO PREVIOUSLY UNSEEN FACES PRESENTED WITH EQUAL PROBABILITY, OF WHICH ONE (E.G., MALE FACE) WAS CHOSEN APRIORI AS THE "NOVEL," TARGET STIMULUS, ALTHOUGH OF COURSE NEITHER STIMULUS WAS NOVEL OR FAMILIAR.

TECHNICAL INFORMATION

SAME AS STUDIES 1 AND 2

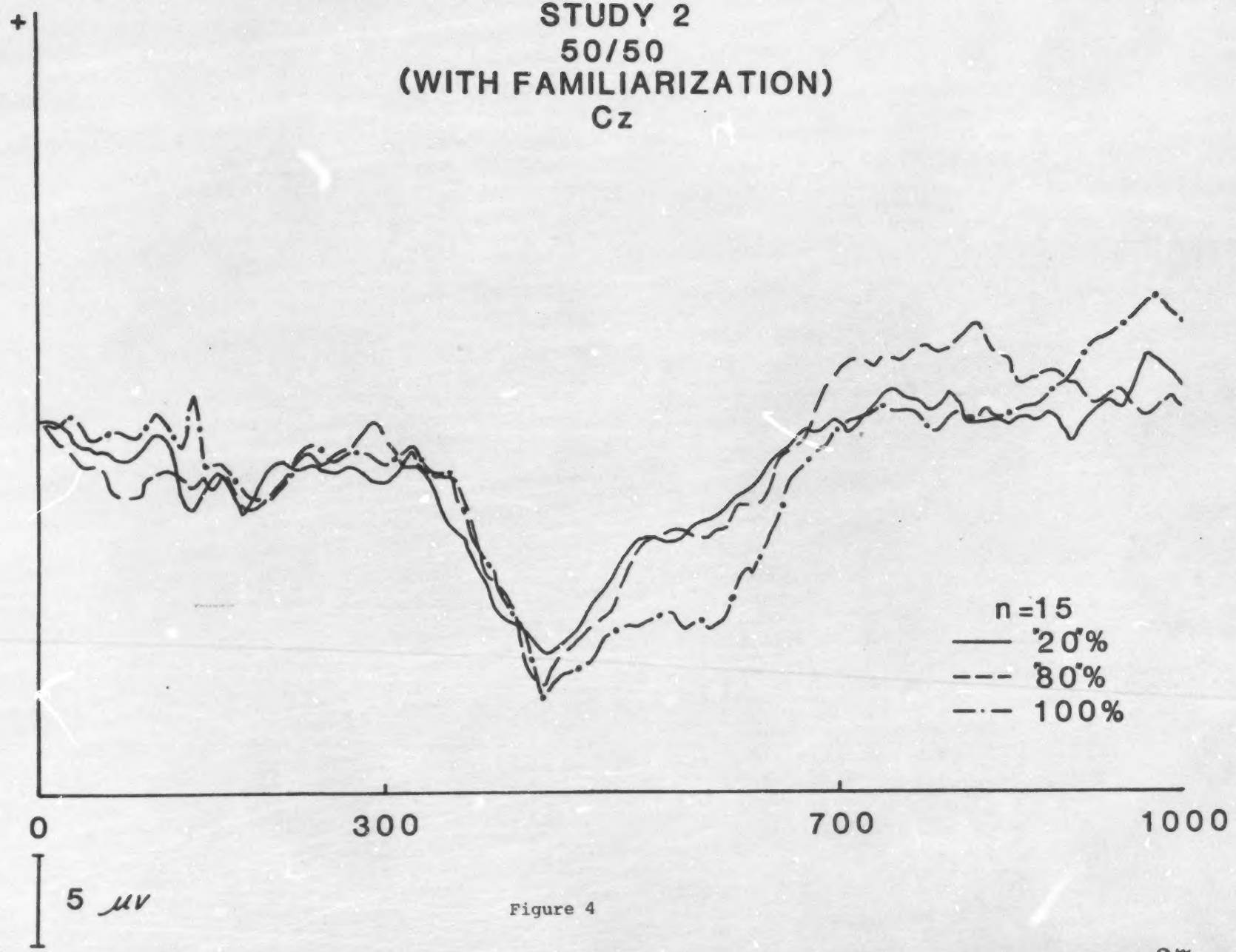

STUDY 2
50/50
(WITH FAMILIARIZATION)
Cz
+
n=15
20%
80%
100%
0
300
700
1000
5 μv

Figure 4

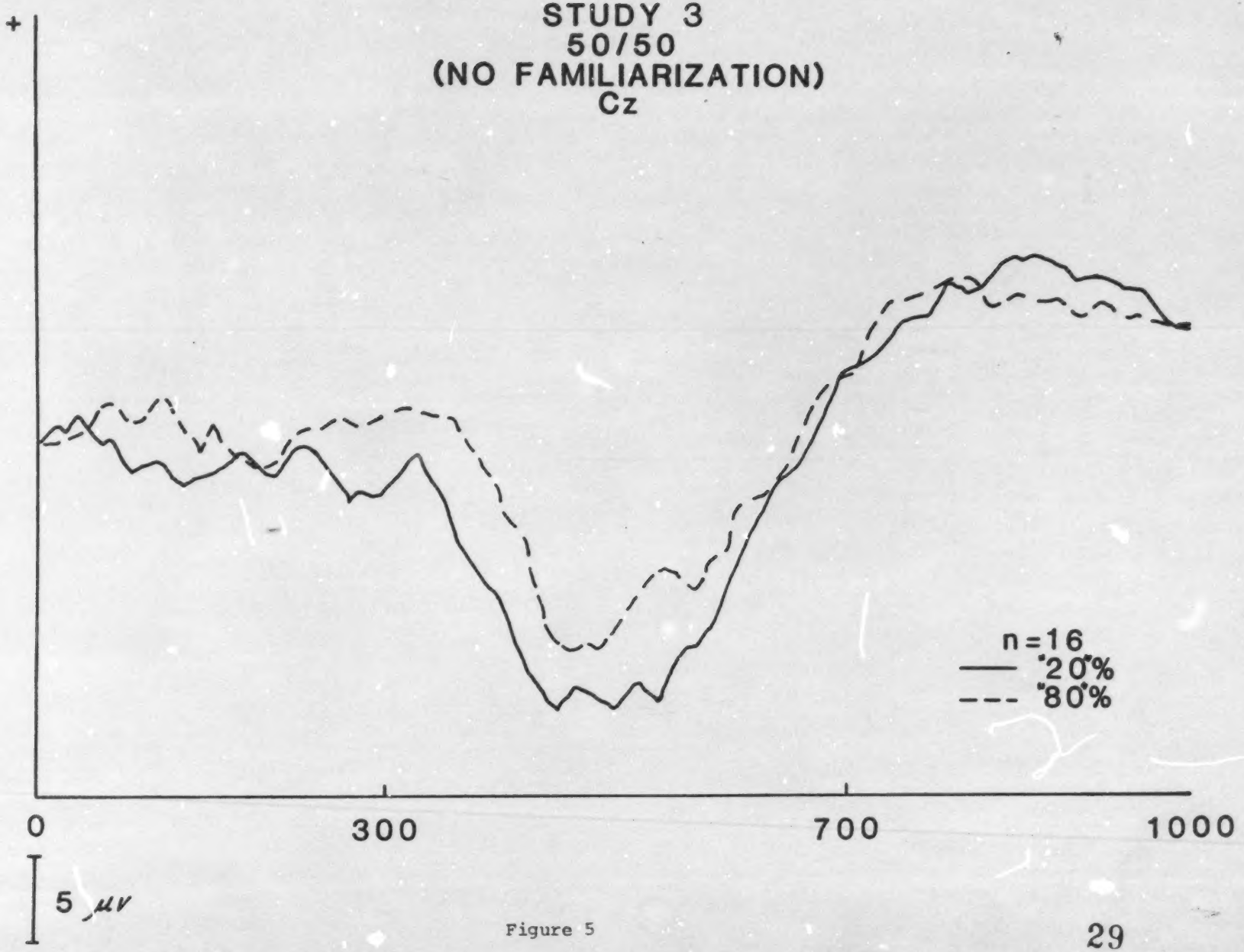

STUDY 3
50/50
(NO FAMILIARIZATION)
Cz
+
n=16
20%
80%
0
300
700
1000
5 μv

Figure 5

CATEGORIZATION STUDY

EXPERIMENTAL DESIGN

FAMILIARIZATION PERIOD: INFANT PRESENTED WITH 30 SEC (ACCUMULATED) EXPOSURE OF PROTOTYPE OF ONE CATEGORY OF STIMULUS (E.G., MALE FACE "A"). NO EEG RECORDED.

TEST PERIOD: 200 TRIALS OF INTERLACE OF HIGH (80%) AND LOW (20%) PROBABILITY TRIALS. THE 80% STIMULI COMPRISED OF 6 EXEMPLARS FROM THE PREVIOUSLY SEEN CATEGORY OF FACES (E.G., MALES), WHILE THE 20% STIMULI WERE COMPRISED OF 6 PREVIOUSLY UNSEEN EXEMPLARS OF A DIFFERENT CATEGORY (E.G., FEMALES).

BACKGROUND/TECHNICAL INFORMATION

EVERYTHING IDENTICAL TO STUDIES 1 - 3, EXCEPT: PZ DATA COLLECTED ON ALL SUBJECTS; RECORDING EPOCH=1200 MSEC; STIMULUS SET COMPRISED OF 6 MALE AND 6 FEMALE FACES, MATCHED FOR LUMINANCE (1.2 LOG FOOT LAMBERTS), SIZE (20 DEG), BACKGROUND, AND EXPRESSION (NEUTRAL).

GRAND MEAN
CATAGORIZATION STUDY
MALE/FEMALE FACES
4 MONTHS